



THE KENNEL CLUB
DOG HEALTH

Breed Health and Conservation Plan



Flat Coated Retriever
2018

INTRODUCTION

The Kennel Club launched a dynamic new resource for breed clubs and individual breeders – the Breed Health and Conservation Plans (BHCP) project – in September 2016. The purpose of the project is to ensure that all health concerns for a breed are identified through evidence-based criteria, and that breeders are provided with useful information and resources to support them in making balanced breeding decisions that make health a priority.

The Breed Health and Conservation Plans take a holistic view of breed health with consideration to the following issues: known inherited conditions, complex conditions (i.e. those involving many genes and environmental effects such as nutrition or exercise levels, for example hip dysplasia), conformational concerns and population genetics.

Sources of evidence and data have been collated into an evidence base (Section 1 of the BHCP) which gives clear indications of the most significant health conditions in each breed, in terms of prevalence and impact. Once the evidence base document has been produced it is discussed with the relevant Breed Health Coordinator and breed health committee or representatives if applicable. Priorities are agreed and laid out in Section 2. A collaborative action plan for the health of the breed is then agreed and incorporated as Section 3 of the BHCP. This will be monitored and reviewed.

SECTION 1: EVIDENCE BASE

Demographics

The Flat Coated Retriever is a Breed Watch category 1 breed, meaning that there are no current visible points of concern for judges to consider when at a judging appointment. The number of new registrations of the breed per year are shown in Table 1, and have decreased slightly over this time period.

Table 1: Number of Flat Coated Retrievers registered per year between 2007 and 2017

Year	Number of new registered Flat Coated Retrievers	Percentage of Flat Coated Retrievers in the KC registered population per year
2007	1718	0.63%
2008	1353	0.50%
2009	1233	0.50%
2010	1438	0.56%
2011	1387	0.57%
2012	1184	0.52%
2013	1299	0.58%
2014	1180	0.53%
2015	1251	0.57%
2016	1348	0.59%
2017	1186	0.49%

The number of Flat Coated Retrievers registered by year of birth between 1980 and 2017 are shown in Figure 1. The 1980 registrations figure appears depressed for all breeds due to registrations moving across to the electronic system from paper files. The trend of registrations over year of birth (1980-2014) was +21.30 per year (with a 95% confidence interval of +13.01 to +29.59), reflecting the overall increase in registrations. [Put simply, 95% confidence intervals (C.I.s) indicate that we are 95% confident that the true estimate of a parameter lies between the lower and upper number stated.]

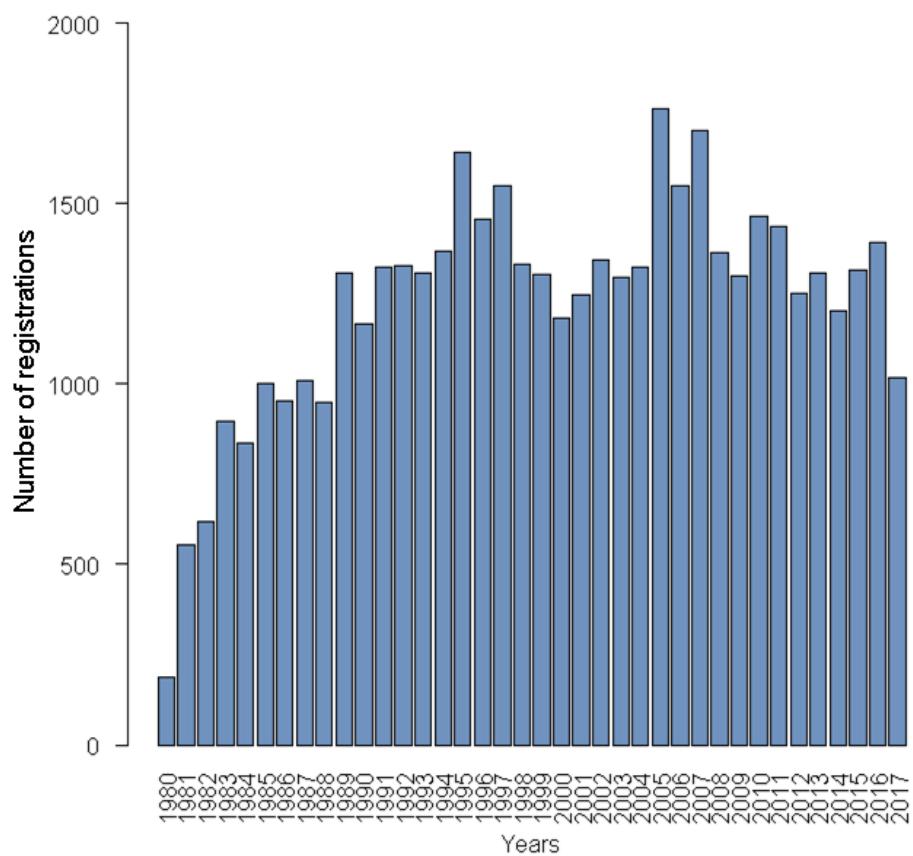


Figure 1: Number of registrations of breed per year of birth, 1980 – 2016

Literature review

The literature review lays out the current scientific knowledge relating to the health of the breed. We have attempted to refer primarily to research which has been published in peer-reviewed scientific journals. We have also attempted to acknowledge possible limitations of the studies reported, including when the research involved dogs in other countries. Whilst there are often strong links between populations of a breed in different countries, there are also often differences between the populations and issues seen in one country may not be seen (or may have a different prevalence) in another. However, it may also be useful for United Kingdom (UK) breeders to be aware of conditions occurring in the breed in other countries which have not yet been seen in the UK population, especially given that movement of breeding stock does occur between countries.

Cardiovascular conditions

No scientific references to conditions in this category could be found for the breed.

Dermatological conditions

No scientific references to conditions in this category could be found for the breed.

Endocrine conditions

No scientific references to conditions in this category could be found for the breed.

Gastrointestinal conditions

No scientific references to conditions in this category could be found for the breed.

Haematological conditions

No scientific references to conditions in this category could be found for the breed.

Hepatic conditions

No scientific references to conditions in this category could be found for the breed.

Immunological conditions

No scientific references to conditions in this category could be found for the breed.

Musculoskeletal conditions

Hip dysplasia: A Finnish study reported that Flat Coated Retrievers in Finland had been participating in the Finnish Kennel Club's Hip Dysplasia Screening and Control Program since 1984, with 64% of registered dogs of the breed undergoing screening. When disease prevalence before 1988 and between 1988 and 1995 were compared, overall dysplasia prevalence in the breed had risen slightly from 16% to 20% although the difference was not statistically significant. However, a significant difference in the prevalence of severe hip dysplasia in Flat Coated Retrievers during these two time periods was found, with this prevalence dropping from 7% to 4% (Leppänen and Saloniemi, 1999). A more recent analysis of UK data from the British Veterinary Association (BVA)/Kennel Club (KC) Hip Dysplasia Scheme found that more than 70% of Flat Coated Retriever dams, and almost 80% of sires, were hip scored. The heritability of hip score in the breed was estimated as 0.28 (s.e. 0.032), which was the lowest of all 15 breeds studied (Lewis et al, 2013).

Patellar luxation: The Flat Coated Retriever was reported to be at elevated risk of patellar luxation, with a breed-associated odds ratio compared to mixed breeds of 2.9 (95% C.I. 1.0 – 8.2), based on dogs which had attended veterinary teaching hospitals in the USA between 1986 and 1995; however this result was based on just nine cases and five non-cases in the breed (LaFond et al, 2002). Between 1990 and 2007, 3,834 Flat Coated Retrievers aged 12 months or older had their stifles graded for patellar luxation by a single certified orthopaedic surgeon using an adapted version of the Putnam scoring system. The prevalence of patellar luxation over this time period was 23.6% (905 dogs affected); 61% of cases involved lateral displacement of the patella (Lavrijsen et al, 2013). The heritability of patellar luxation in the Dutch population of the breed was estimated as 0.17 ± 0.03 , suggesting that environmental factors play an important role in the manifestation of the condition.

Spondylosis deformans and diffuse idiopathic skeletal hyperostosis (DISH): This condition affects the entire skeleton and results in ossification of soft tissues, including spinal ligaments and sites of attachment of tendons to bone, resulting in stiffness and pain. A retrospective radiographic study of dogs over one year of age referred to the Utrecht University Veterinary Medical Teaching Hospital between February 2003 and January 2008 revealed an overall prevalence of DISH of 3.8% (78 cases in 2041 dogs). The prevalence of spondylosis and/or DISH in Flat Coated Retrievers was 42.6% (26 cases in 61 dogs of the breed); and the breed had an odds ratio of 2.8 for developing spondylosis and 7.7 for developing DISH compared to dogs of other breeds (Kranenburg et al, 2011)

Neoplastic conditions

Histiocytic sarcoma (HS): A cohort study of 174 British Flat Coated Retrievers, which were healthy and aged between two and seven years of age at the start of the study in 1996, found that 42.0% (72 dogs) died from confirmed neoplasia and 11.6% (20 dogs) died of unconfirmed tumours. Soft tissue sarcoma, especially histiocytic sarcoma, was the predominant cancer type representing 44% (32 dogs) of neoplasms (Dobson et al, 2009). A subsequent study of all cases of soft tissue sarcoma submitted to the ongoing Flat Coated Retriever Cancer Survey (FRCS) at the Department of Veterinary Medicine, University of Cambridge from 1996 to 2009 included data on 180 dogs. The majority (57%, 101 lesions) were primary limb lesions while 26% (47 dogs) had visceral, mainly splenic, lesions with no peripheral primary tumour (Constantino-Casas et al, 2011).

Osteosarcoma: A study of insured Swedish dogs under 10 years old between 1995 and 2002 found 764 dogs were diagnosed with bone tumours between 1995 and 2002. The Flat Coated Retriever was the sixth most common breed to be diagnosed with osteosarcoma, with 75 cases in the breed, giving an incidence rate of 35 cases (95% C.I. 27 - 43) per 10,000 dog years at risk (DYAR); this compared to the rate in all breeds combined of 5.5 cases per 10,000 DYAR (Egenvall et al, 2007).

Neurological conditions

No scientific references to conditions in this category could be found for the breed.

Ocular conditions

Primary closed angle glaucoma (PCAG): A UK study of 389 Flat Coated Retrievers with no prior evidence of ocular disease, undertaken at the Animal Health Trust (AHT), suggested that the expected incidence of glaucoma in the breed in the UK was 1% i.e. one case per hundred dogs of the breed (Wood et al, 1998). The degree of pectinate ligament dysplasia (PLD) present was closely associated with the probability that a particular dog would develop glaucoma, and PLD appeared to be highly heritable at 0.7. A subsequent study of Flat Coated Retrievers in the UK (39 dogs) and Switzerland (57 dogs) compared the results of two gonioscopic examinations at least one year and 11 months apart and found progression of PLD grade in 40.6% cases (39 of 96 dogs); all PLD grades either progressed or remained static, no reduction in grade was observed (Pearl et al, 2015). A recent study of 170 dogs of the breed in the UK found that 37.6% (64 dogs) had no PLD, 41.2% (70 dogs) were mildly affected and 21.2% (36 dogs) were moderately affected (Oliver et al, 2016). No dogs of the breed were found to have the most severe grade PLD.

Other ocular conditions: The American College of Veterinary Ophthalmologists (ACVO) consider the Flat Coated Retriever to be predisposed to glaucoma, distichiasis, corneal dystrophy, persistent pupillary membranes, cataract and retinopathy (Genetics Committee of the ACVO, 2016). Between 2010 and 2017, 3213 dogs of the breed were examined by the ACVO and prevalence data are shown in Table 2 alongside data from previous years. Overall, 66.6% (2141 of 3213) of dogs of the breed examined between 2010 and 2017 had healthy eyes unaffected by any disease conditions. However, it is important to bear in mind that the dogs were from America and therefore the data may not be representative of UK dogs.

Table 2: ACVO examination results for breed, 1991 – 2017

Disease Category/Name	Percentage of Dogs Affected		
	1991-1999 (n=2598)	2000-2009 (n=3681)	2010-2017 (n=3213)
Eyelids			
Distichiasis	12.5%	11.5%	13.9%
Cornea			
Corneal dystrophy	0.8%	0.5%	0.6%
Uvea			
Persistent pupillary membranes	1.6%	2.3%	6.6%
Lens			
Cataract (all types)	8.9%	15.5%	19.7%
Retina			
Retinopathy	0.0%	0.0%	20.7%

Adapted from: <https://www.ofa.org/diseases/eye-certification/blue-book>

Reproductive conditions

No scientific references to conditions in this category could be found for the breed.

Respiratory conditions

No scientific references to conditions in this category could be found for the breed.

Urological conditions

Renal disease: A recent study of Swedish insurance claim records from 1995-2006 reported an overall incidence of kidney disease of 15.8 (95% C.I. 15.3-16.2) cases per 10,000 dog years at risk (DYAR) for a population of 665,245 dogs; for Flat Coated Retrievers the kidney disease incidence was 27 (95% C.I. 22 - 33) cases per 10,000 DYAR, based on 92 cases in 33,897 DYAR, suggesting that the breed is at increased risk of kidney disease compared with dogs of other breeds (Pelander et al, 2015). Considering 548,346 life insurance policies, the total kidney-related mortality was 9.7 (95% C.I. 9.3-10.2) deaths per 10,000 DYAR; for Flat Coated Retriever the kidney-related mortality was 25 (95% C.I. 19 - 31) deaths per 10,000 DYAR, based on 69 deaths in 27,207 DYAR; again suggesting an increased risk of mortality due to kidney disease compared to dogs of other breeds.

Purebred/pedigree dog health survey results

2004 Morbidity results: Health information was collected for 926 live Flat Coated Retrievers of which 549 (59%) were healthy and 377 (41%) had at least one reported health condition. The top categories of diagnosis were musculoskeletal (15.3%, 102 of 666 reported conditions), benign neoplasia (13.1%, 87 of 666 reported conditions), reproductive (12.0%, 80 of 666 reported conditions) and dermatologic (9.8%, 65 of 666 reported conditions). The most frequently reported specific conditions were lipoma (5.3% prevalence, 49 cases), false pregnancy (5.3% prevalence, 30 cases in the 563 female Flat Coated Retrievers in the survey), otitis externa (3.6% prevalence, 33 cases), histiocytoma (3.2%, 30 cases) and GDV (2.3% prevalence, 21 cases).

2004 Mortality results: A total of 610 deaths were reported for the breed. The median age at death for Flat Coated Retrievers was 9 years and 10 months (min = 4 months, max = 16 years and 11 months). The most frequently reported causes of death by organ system or category were cancer (54.3%, 331 of 610 deaths), old age (8.9%, 54 deaths), cardiac (6.2%, 38 deaths) and gastrointestinal (5.9%, 36 deaths). The most frequently reported specific causes of death behind cancer and old age were GDV (3.6%, 22 deaths) and heart failure (2.6%, 16 deaths).

2014 Morbidity results: Health information was collected for 672 live Flat Coated Retrievers of which 376 (56%) were healthy and 296 (44%) had at least one reported health condition. The most frequently reported specific conditions were lipoma (14.6% prevalence, 85 cases), skin (cutaneous) cyst (6.9%, 40 cases), skin cancer/tumour (5.7% prevalence, 33 cases), arthritis (4.5% prevalence, 26 cases) and skin lump (4.3% prevalence, 25 cases). Further analysis of the morbidity results suggested that the Flat Coated Retriever was at increased risk of bone cancer, distichiasis, GDV, lipoma, lymphoma, patellar luxation, skin cyst, skin cancer, skin lump and spondylosis compared to the average risk for dogs of all breeds (Wiles et al, 2017).

2014 Mortality results: A total of 225 deaths were reported for the breed. The median age at death for Flat Coated Retrievers was 10 years. The most frequently reported causes of death were cancer - unspecified (19.6%, 144 deaths), bone tumour (10.7%, 24 deaths) and splenic tumour (8.0%, 18 deaths).

VetCompass results

No VetCompass data were currently available for the Flat Coated Retriever.

Insurance data

UK Agria data

Insurance data were available for Flat Coated Retrievers insured with Agria UK. 'Exposures' are equivalent to one full policy year; in 2016 there were 1,065 free exposures, 502 full exposures and 589 claims, in 2017 these figures were 874, 528 and 762 respectively. Full policies are available to dogs of any age. Free policies are available to breeders of Kennel Club registered puppies and cover starts from the time the puppy is collected by the new owner; cover under free policies lasts for five weeks from this time. It is possible that one dog could have more than one settlement for a condition within the 12-month period shown. The top 10 conditions by number of settlements, for authorised claims where treatments started between 1st October 2016 and 31st September 2017, are shown in Table 3 below.

Table 3: Top 10 conditions and number of settlements for each condition between 1st October 2016 and 31st September 2017 for Flat Coated Retrievers insured with Agria UK

Condition	Number of settlements
Histiocytic sarcoma	57
Skin allergy ^{\$}	34
Atopy ^{\$}	33
Cruciate ligament disorders	27
Lameness	24
Osteoarthritis/degenerative joint disease	22
Seizures, epileptic convulsions	21
Skin tumour	21
Soft tissue sarcoma	17
Cushing's syndrome	15

^{\$} N.B. - Allergy is any exaggerated immune response to a foreign antigen regardless of mechanism. A dog can be allergic without being atopic. Atopy is a genetic predisposition to an exaggerated Immunoglobulin E (IgE)-mediated immune response to allergens in the environment. The treatment of atopy will be different to the treatment of non-atopic allergy.

Swedish morbidity and mortality insurance data were also available from Agria for the Flat Coated Retriever. Reported rates are based on dog-years-at-risk (DYAR) which take into account the actual time each dog was insured during the period (2006-2011). The number of DYAR for the Flat Coated Retriever in Sweden during this period was between 1,000 and 2,000.

Swedish Agria insurance morbidity data

The most common specific causes of veterinary care episodes (VCEs) for Agria-insured Flat Coated Retrievers in Sweden between 2006 and 2011 are shown in Figure 2. The top specific causes of VCEs were skin tumour, vomiting/diarrhoea/gastroenteritis, otitis, pain/locomotor signs and skin trauma.

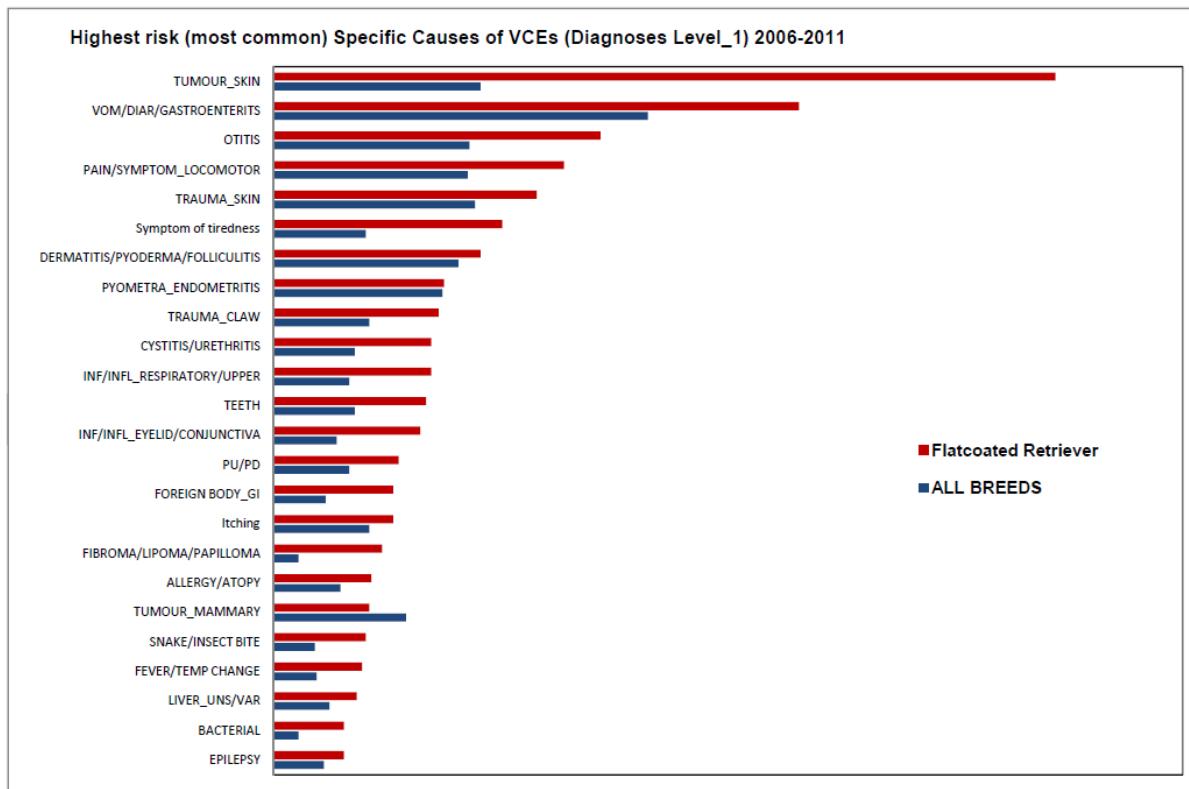


Figure 2: The most common specific causes of VCEs for the Flat Coated Retriever compared to all breeds in Sweden between 2006 and 2011, from Swedish Agria insurance data.

When relative risk of specific causes of VCEs was compared for the Flat Coated Retriever to all breeds, some interesting findings were reported. The specific causes of VCEs ordered by relative risk are shown in Figure 3. In this analysis, the top specific causes of VCEs ordered by relative risk were hyperthyrosis, liver tumour, tumour of the lower respiratory tract, distichiasis/trichiasis and bone tumour. Rare conditions that occur sporadically may appear as a high relative risk; given that a number of the conditions in Figure 3 do not appear in Figure 2, this caveat may well apply to these conditions.

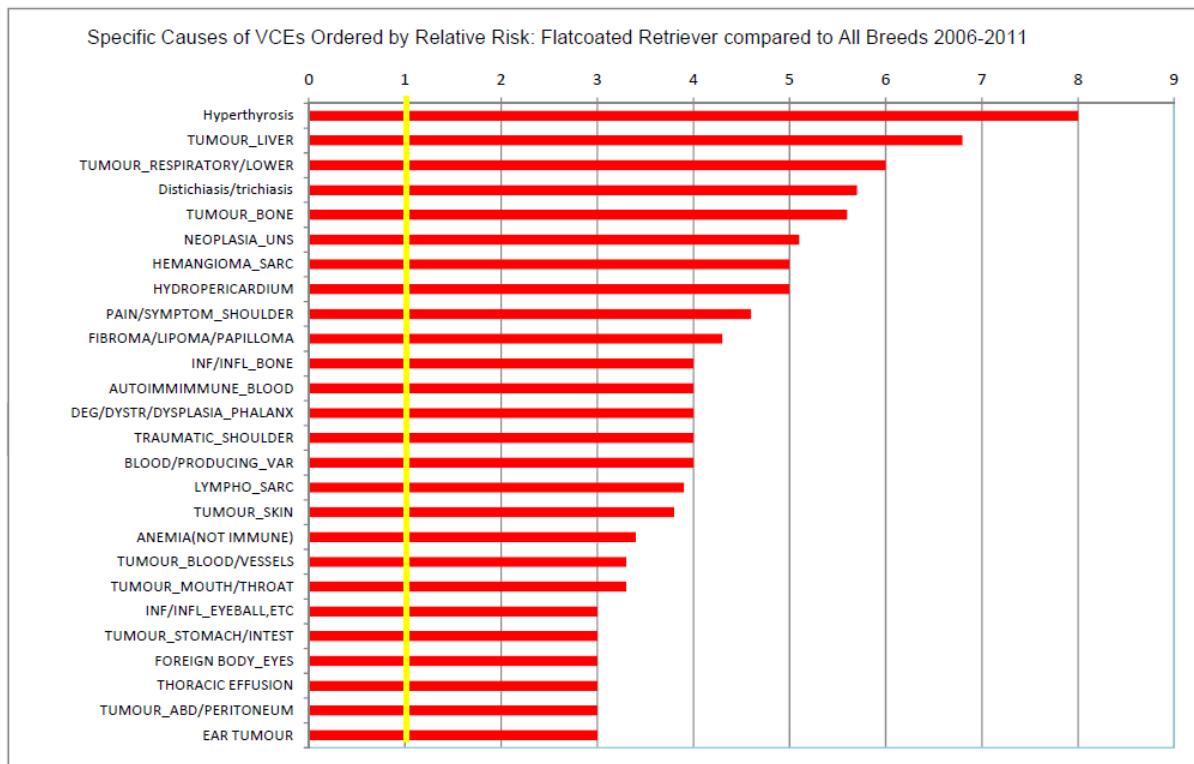


Figure 3: The specific causes of VCEs for the Flat Coated Retriever ordered by relative risk compared to all breeds in Sweden between 2006 and 2011, from Swedish Agria insurance data. The yellow line indicates the baseline risk for all breeds.

Swedish Agria insurance mortality data

Median age at death for the Flat Coated Retriever from Swedish Agria insurance data was 7.5 years for males and 7.9 years for females. Agria have a maximum age to which a dog can be life insured, which varies somewhat across breeds and years. Many owners also choose not to insure their dogs after a certain age, as the cost of the premiums become more expensive. For these reasons the median age at death from the Swedish Agria insurance data is artificially depressed for all breeds compared to that reported from surveys or other sources. The most common specific causes of death or euthanasia for Agria-insured Flat Coated Retrievers in Sweden between 2006 and 2011 are shown in Figure 4. The most common specific causes of death were bone tumour, lymphoma/lymphosarcoma, tumour of the lower respiratory tract and liver tumour.

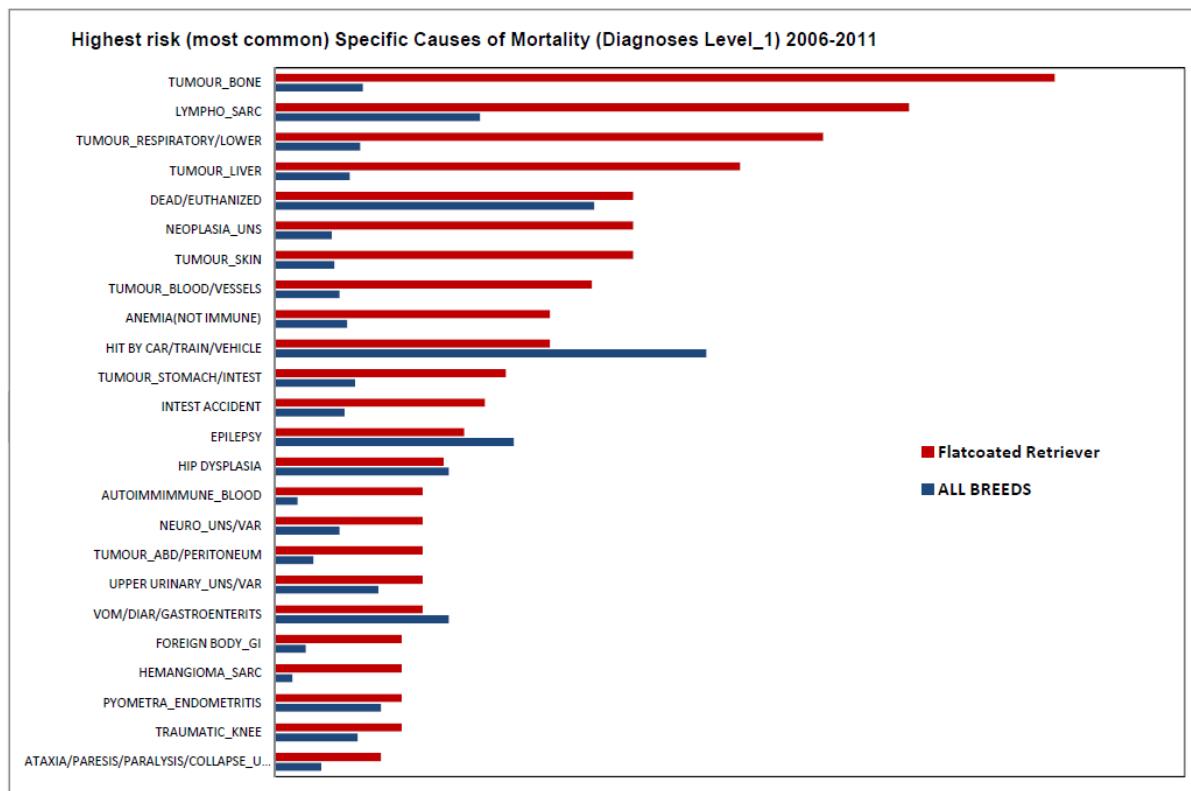


Figure 4: The most common specific causes of death for the Flat Coated Retriever compared to all breeds in Sweden between 2006 and 2011, from Swedish Agria insurance data.

Breed-specific health surveys

2006 FLATCOATED RETRIEVER SOCIETY HEALTH SURVEY

This survey was believed to be the largest survey undertaken investigating the breed's health in the UK, with data collected on 1,229 dogs. In total 351 deaths were recorded, of which 57 had died from cancer; almost half of these dogs (43%) were over ten years old at the time of death. Other reported causes of death included organ failure, old age, gastric torsion and accident. Further information can be found here: <http://www.flatcoated-retriever-society.org/images/stories/health/health%20survey%202006.pdf>

2011 FLATCOATED RETRIEVER SOCIETY HEALTH SURVEY

Data were received about 878 dogs of the breed. Prevalence estimates of conditions reported in the 2011 are shown in Table 4, alongside those from the 2006 survey.

Table 4: Conditions reported in the 2011 Flat Coated Retriever health survey and their apparent prevalence estimates, alongside those from the 2006 survey.

Condition	2011 survey prevalence	2006 survey prevalence
Benign tumours	25.0%	25.0%
Skin and ear disease	12.0%	7.0%
Arthritis	8.0%	11.0%
Malignant tumours	6.0%	2.5%
Ocular disease	4.0%	4.0%
Food intolerance / allergy	3.4%	4.0%
Other skeletal conditions	3.0%	3.0%
Digestive tract disease	2.5%	2.0%
Gastric torsion / bloat (GDV)	2.3%	3.0%
Organ disease*	2.3%	-
Neurological disease\$	2.0%	2.0%
Luxating patellae	1.7%	2.0%
Hypothyroidism	1.5%	2.0%
'Other' disease	3.0%	5.0%
Laryngeal paralysis	1.0%	-
Osteochondrosis dissecans (OCD)	<1.0%	<1.0%
Glaucoma	<1.0%	<1.0%

* 94% heart disease, one case renal disease.

\$ 17 dogs; 11 seizures, 4 epilepsy, 2 other neurological deficits.

In addition to the live dogs included in the survey, 300 deaths were reported to have occurred since the 2006 survey. Cancer was again the most frequently reported cause of death, accounting for 54% of deaths. Full results and analysis of the survey can be found here: <http://www.flatcoated-retriever-society.org/images/stories/health/anays2011.pdf>

Visual health check reports/clinical reports/judges' health monitoring

The Flat Coated Retriever is currently listed as a category 1 breed on Breed Watch, meaning there are currently no listed visible points of concern for judges to report on. No optional reports have been received from judges since Breed Watch began.

Breed Club health activities

The breed has an active Breed Health Coordinator and health sub-committee who lead a number of health testing sessions and health surveys. All four breed clubs have dedicated health pages on their websites.

The breed's society supports a number of health initiatives in their health strategy, including: a cause of death register, DNA banking at the Animal Health Trust (AHT), the AHT/KC Give a Dog a Genome project, screening of patellar luxation at breed championship shows, group studies to investigate the impact of lifestyle on health, the popular sire effect, renal dysplasia research and cancer research at the University of Cambridge's Veterinary School. Two health seminars have been held in the past five years, with one held in 2013 and another in 2016.

The breed has also launched a breed patellar screening scheme with sessions being organised at shows, including one in June 2018.

BHC annual report

The 2017 Breed Health Coordinator's Annual Health Report yielded the following response to 'please list and rank the three health and welfare conditions that the breed considers to be currently the most important to deal with in your breed': 1 histiocytic sarcoma, 2 glaucoma, 3 epilepsy, cardiomyopathy and patellar luxation. In terms of what the breed has done in the last year to help tackle these listed health and welfare concerns, the breed has supported ongoing research into histiocytic sarcoma in conjunction with the University of Cambridge Oncology department, been holding eye testing sessions to monitor goniodysgenesis and supporting ongoing DNA research at the AHT, and monitor the incidence of epilepsy, cardiomyopathy and patellar luxation, with owners encouraged to report any such conditions to their BHC.

DNA test results

There are currently no DNA tests recognised by the Kennel Club for the Flat Coated Retriever. DNA test results are only recorded for Official Kennel Club DNA Testing Schemes which involve collaboration between the Kennel Club, the breed clubs and the DNA testing facilities. DNA tests available for the breed but not currently recorded by the Kennel Club include: a test for a mutation which increases risk of degenerative myelopathy undertaken by Paw Print Genetics and VetGen, and a test for obesity/adiposity (ADI) available through Laboklin and the AHT.

Canine Health Scheme results and EBVs

Kennel Club (KC) Assured Breeders are required to participate in the British Veterinary Association (BVA)/KC Hip Dysplasia Scheme and undergo gonioscopy testing. They are further strongly recommended to test their dogs under the BVA/KC/International Sheep Dog Society (ISDS) eye scheme, and recommended that bitches under two years are not to produce a litter, bitches are not to produce more than three litters in their lifetime, and bitches are not to produce more than one litter within a 12-month period. Estimate breeding values (EBVs) are available for the breed for hip score.

HIPS

A total of 3396 Flat Coated Retrievers have gone through the BVA/KC Hip Dysplasia Scheme in the 15 years to the end of 2017, with the median score of 7 (range 0 to 84).

Hip score categories received by Flat Coated Retrievers which participated in the BVA/KC Hip Dysplasia Scheme between 1990 and 2017 are shown in five year blocks (which can be considered to approximate to a generation) in Figure 5 below. The categories correspond to those assigned under the FCI (Europe)'s hip grading scheme; for one hip, a 'normal' hip scores 0-3, borderline scores 4-8, mild HD scores 9-18, moderate HD scores 19-30 and severe HD represents a score greater than 30. Further information on these categories can be found here:

https://www.bva.co.uk/uploadedFiles/Content/Canine_Health_Schemes/chs-comparison-of-hd-schemes.pdf. Over this time period there appears to have been a definite increase in the proportion of Flat Coated Retriever receiving normal hip scores and a corresponding decline in those receiving borderline, mild, moderate and severe scores.

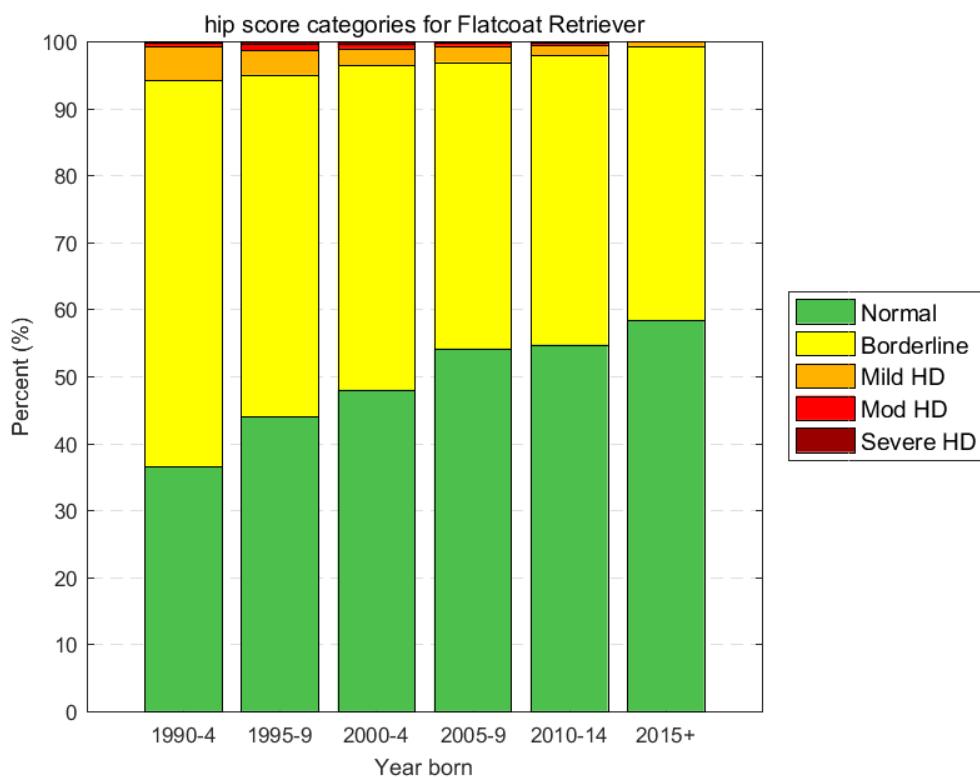


Figure 5 – Hip score categories for Flat Coated Retrievers which participated in the BVA/KC Hip Dysplasia Scheme between 1990 and 2016, in 5-year blocks.

Estimated Breeding Values (EBVs) are available for hip scores in this breed. Figure 6 shows the five year rolling trend in EBVs by year of birth in the Flat Coated Retriever. It appears that EBVs have decreased very slightly since 1990. This indicates a very slight improvement in (lowering of) genetic risk of hip dysplasia as determined by the BVA/KC hip score, most likely as a result of selection, but suggests that selection in this area is not intense.

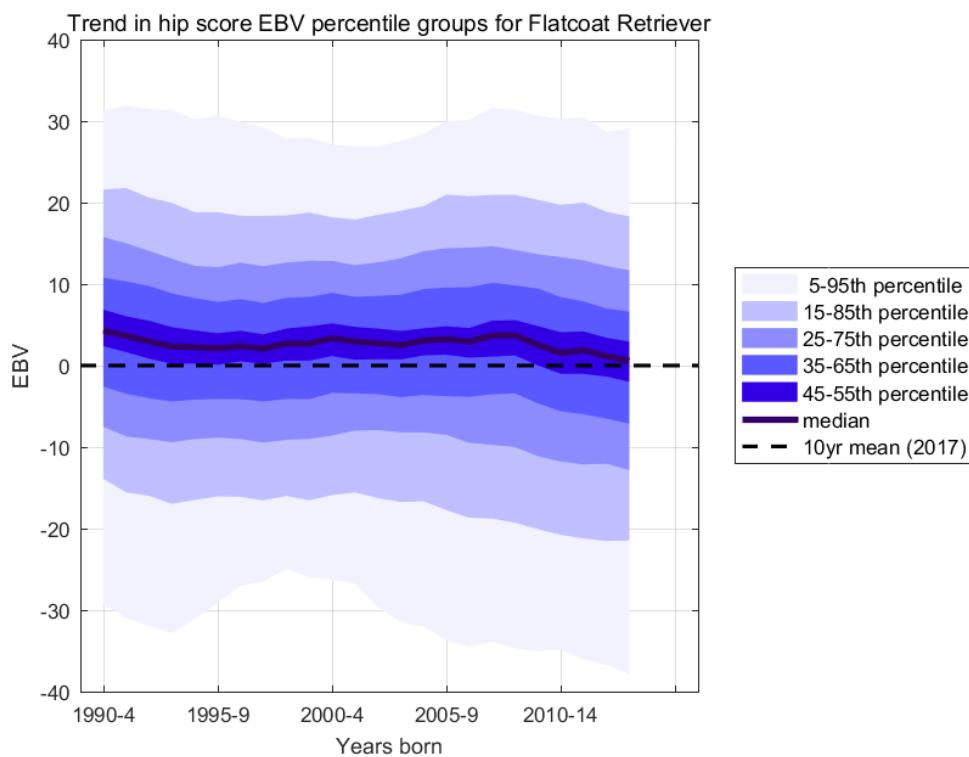


Figure 6: Trend in hip score EBV, with percentile groups, for the Flat Coated Retriever for years of birth since 1990.

ELBOWS

In total 386 Flat Coated Retrievers have been elbow scored as part of the BVA/KC Elbow Dysplasia Scheme since the scheme launched in 1998; the scores received are shown in Table 5 below. Just 2.1% (8 of 386) Flat Coated Retrievers scored were diagnosed with some degree of elbow pathology.

Table 5: Elbow scores and number of dogs receiving those scores since 1998 for the Flat Coated Retrievers

Elbow score	Number of dogs	Percentage
0	378	98.0%
1	4	1.0%
2	2	0.5%
3	2	0.5%

EYES

The breed is currently on Schedule A for goniodygenesis / pectinate ligament abnormality (PLA) / primary glaucoma and Schedule B for generalised progressive retinal atrophy (GPRA) under the BVA/KC/International Sheep Dog Society (ISDS) Eye Scheme. Schedule A lists the known inherited eye conditions in the breeds where there is enough scientific information to show that the condition is inherited in the breed, often including the actual mode of inheritance and in some cases even a DNA test. Schedule B lists those breeds in which the conditions are, at this stage, only suspected of being inherited. However, the BVA still records the results of dogs of other breeds which have participated in the scheme. The results of Eye Scheme examinations of the breed which have taken place since 2012 are shown in Table 6.

Table 6: Reports on dogs of the breed which have participated in the BVA/KC/ISDS Eye Scheme since 2007

Year	AFFECTED G	UNAFFECTED G	Total Tested
2007	19	254	273
2008	17	210	227
2009	13	192	205
2010	4	215	219
2011	8	226	234
2012	16	223	239
2013	8	203	211
2014	9	201	210
2015	2	212	214
2016	3	160	163
Grand Total	99	2171	2195

G = goniodygenesis/ primary glaucoma (risk)

Since 1st July 2017, 'G' has been replaced with pectinate ligament abnormality (PLA), for which a grade is assigned from 0 (unaffected) to 3 (severely affected). These results could not be accessed at this time. The results collated by the BVA for gonioscopy examinations undertaken in Flat Coated Retrievers from 1st January to 30th April 2018 are shown in Table 7.

Table 7: PLA grades received by 73 Flat Coated Retrievers which underwent gonioscopy under the BVA/KC/ISDS Eye Scheme between 1st January and 30th April 2018

PLA grade	Number of dogs of the breed
0	37
1	29
2	6
3	1
TOTAL	73

The BVA also records 'sightings', in which non-Schedule A conditions are recorded for dogs which have participated in the BVA/KC/ISDS Eye Scheme. The information shown in Table 8 relates to Flat Coated Retrievers which have participated in the scheme since 2012.

Table 8: Reports on dogs of the breed which have participated in the BVA/KC/ISDS Eye Scheme since 2012

Year	Number seen	Comments
2012	329 adults 1 litter	16 – distichiasis 6 – retinopathy 4 – persistent pupillary membranes (PPM) 1 – entropion 1 – ectropion 1 – persistent hyperplastic primary vitreous (PHPV) 1 – other cataract 1 – recessed optic discs
2013	311 adults 0 litters	21 – distichiasis 11 – PPM 7 – other cataract 3 – ectropion 1 – corneal lipid deposition 1 – nuclear cataract 1 – posterior polar subcapsular cataract (PPSC) 1 – posterior segment coloboma 1 – eyelid mass 1 – micropunctum
2014	271 adults 0 litters	10 – distichiasis 2 – ectropion 2 – PPM 2 – PPSC 1 – PHPV
2015	287 adults 0 litters	10 – distichiasis 4 – nuclear cataract 3 – abnormal pigment deposition (APD) 3 – other cataract 2 – PPSC 2 – posterior segment coloboma 2 – entropion 1 – ectropion 1 – corneal lipid deposition 1 – PPM
2016	211 adults 0 litters	8 – distichiasis 3 – focal retinopathy 2 – PPSC 2 – other cataract 1 – PHPV

Breed Club Recommendations

Bitches under two years not to produce a litter, bitches not to produce more than three litters in their lifetime, bitches not to produce more than one litter within a 12-month period.

Reported caesarean sections

When breeders register a litter of puppies, they are asked to indicate whether the litter was delivered (in whole or in part) by caesarean section. In addition, veterinary surgeons are asked to report caesarean sections they perform on Kennel Club registered bitches. The consent of the Kennel Club registered dog owner releases the veterinary surgeon from the professional obligation to maintain confidentiality (vide the Kennel Club General Code of Ethics (2)). There are some caveats to the associated data; it is doubtful that all caesarean sections are reported, so the number reported each year may not represent the true proportion of caesarean sections undertaken in each breed. In addition, these data do not indicate whether the caesarean sections were emergency or elective. The number of litters registered per year for the breed and the number and percentage of reported caesarean sections in the breed for the past 10 years are shown in Table 9.

Table 9: Number and percentage of litters of breed registered per year and number of caesarean sections reported per year, 2008 to 2017.

Year	Number of Litters Registered	Number of C-sections	Percentage of C-sections
2007	212	0	0.00%
2008	175	0	0.00%
2009	170	0	0.00%
2010	182	0	0.00%
2011	187	2	1.07%
2012	158	8	5.06%
2013	159	3	1.89%
2014	156	4	2.56%
2015	160	10	6.25%
2016	175	16	9.14%
2017	137	6	4.38%

Genetic diversity measures

The effective population size is the number of breeding animals in an idealised, hypothetical population that would be expected to show the same rate of loss of genetic diversity (rate of inbreeding) as the population in question; it can be thought of as the size of the 'gene pool' of the breed. In the population analysis undertaken by the Kennel Club in 2015, an estimated effective population size of 67.9 was reported (estimated using the rate of inbreeding over the period 1980-2014). An effective population size of less than 100 (inbreeding rate of 0.50% per generation) leads to a dramatic increase in the rate of loss of genetic diversity in a breed/population (Food & Agriculture Organisation of the United Nations, "Monitoring animal genetic resources and criteria for prioritization of breeds", 1992).

Annual mean observed inbreeding coefficient (showing loss of genetic diversity) and mean expected inbreeding coefficient (from simulated 'random mating') over the period 1980-2014 are shown in Figure 7. As with most breeds, the rate of inbreeding was at its highest in this breed in the 1980s and 1990s. This represents a 'genetic bottleneck', with genetic variation lost from the population. However, since 2000 the rate of inbreeding has flattened, implying maintenance of genetic diversity (possibly through the use of imported animals). It should be noted that, while animals imported from overseas may appear completely unrelated, this is not always the case. Often the pedigree available to the Kennel Club is limited in the number of generations, hampering the ability to detect true, albeit distant, relationships. For full interpretation see Lewis et al, 2015

<https://cgejournal.biomedcentral.com/articles/10.1186/s40575-015-0027-4>.

The current annual breed average inbreeding coefficient is 6.2%. This value is calculated each June and represents the average inbreeding coefficient of all dogs of the breed registered between January and December of the previous year i.e. in 2016.

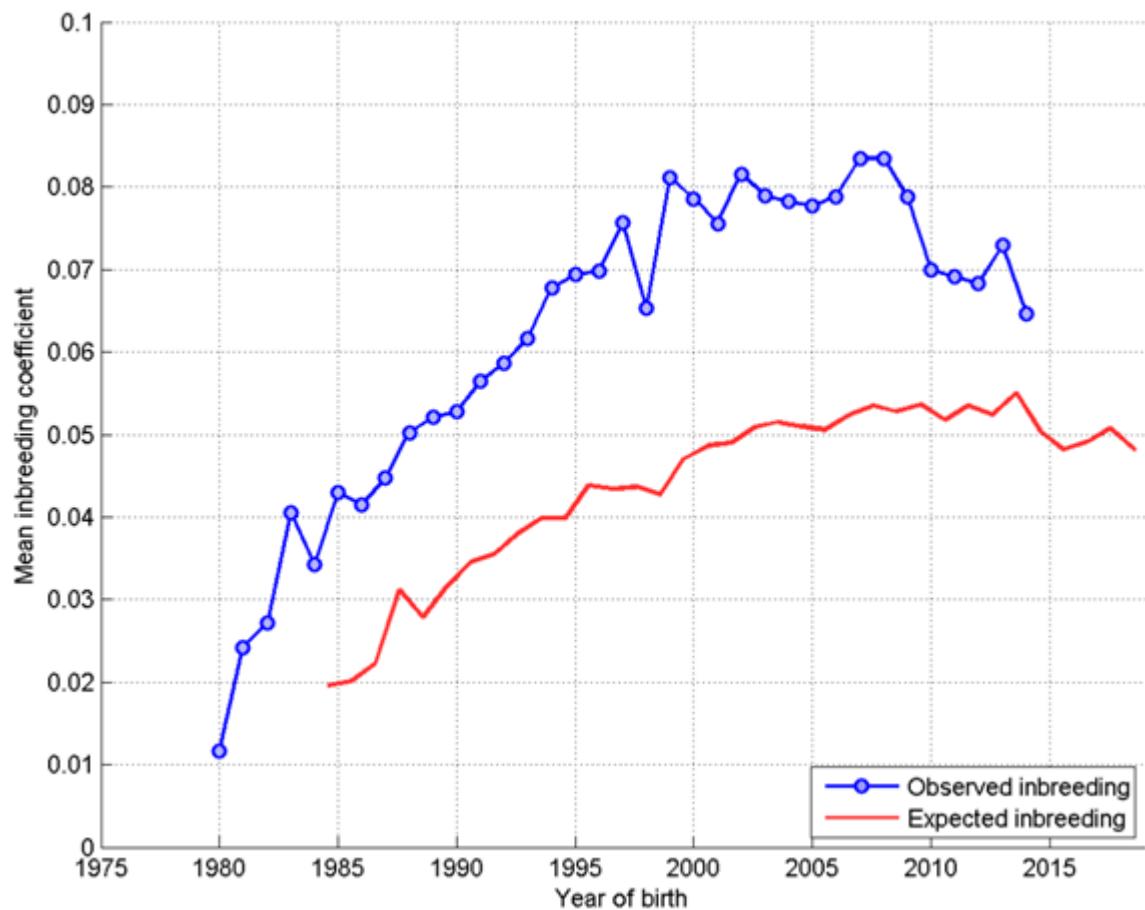


Figure 7: Annual mean observed and expected inbreeding coefficients.

Below is a histogram ('tally' distribution) of number of progeny per sire and dam over each of seven five-year blocks (Figure 8). A longer 'tail' on the distribution of progeny per sire is indicative of 'popular sires' (few sires with a very large number of offspring, known to be a major contributor to a high rate of inbreeding). There appears to be extensive use of popular dogs as sires in this breed (the 'tail' of the blue distribution in Figure 8).

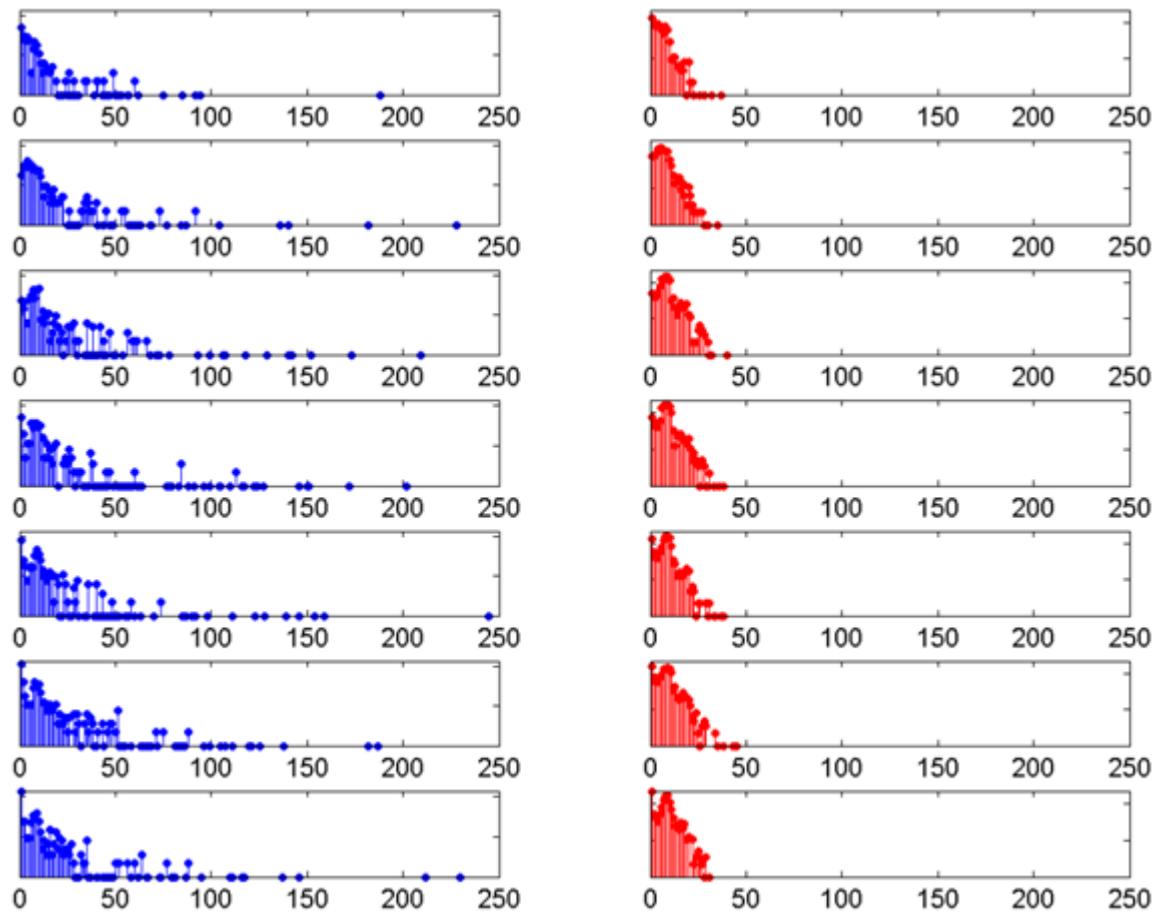


Figure 8: Distribution of progeny per sire (blue) and per dam (red) over 5-year blocks (1980-4 top, 2010-14 bottom). Vertical axis is a logarithmic scale.

Current research projects

The Flat Coated Retriever is one of the breeds in the AHT's Give a Dog a Genome project; the health conditions given as concerns for the breed were dilated cardiomyopathy, histiocytic sarcoma and renal dysplasia. DNA from an individual affected with histiocytic sarcoma has been sent for sequencing, and the data will be shared with Benoit Hedan at Rennes and Jane Dobson at the University of Cambridge.

Research is also ongoing at the AHT into glaucoma in the breed.

Histiocytic sarcoma research continues at the University of Cambridge, and at the USA National Institute of Health, Bethesda, Maryland.

SECTION 2: PRIORITIES

A meeting was held with Flat Coated Retriever breed club representatives on 9th August 2018 to discuss Section 1 of the BHCP and agree the priority issues for the health of the breed.

Despite there being no cardiovascular conditions found in the literature review, the breed representatives mentioned that dilated cardiomyopathy (DCM) appears to be anecdotally affecting the breed, with concerns particularly being raised on social media. Currently there are no insurance or survey data to support this.

Three musculoskeletal conditions were listed, hip dysplasia, patellar luxation and spondylosis deformans and diffuse idiopathic skeletal hyperostosis (DISH). The group discussed the improvement in hip scores in the breed since the BVA/KC Hip Dysplasia scheme was introduced, with prevalence for the condition significantly decreasing. It was also noted that the heritability for the condition in the breed is low, specifically in comparison to other breeds, probably reflecting that significant selection in this area has already occurred. The breed have discussed further research possibilities with Dr Dylan Clements at the University of Edinburgh with regard to patellar luxation, and have currently collected data for approximately 100 dogs. With respect to DISH the breed representatives have seen reports of spondylosis anecdotally but mostly in dogs of an older age, but a diagnosis of DISH had not been made as far as they were aware. It was noted that if dogs are affected with spondylosis the condition is not often debilitating and therefore it is not currently a concern. It was highlighted that this condition may not necessarily be breed specific but common across similar sized breeds.

The neoplastic or cancer category had two specific conditions listed: histiocytic sarcoma and osteosarcoma. The breed clubs are aware of the high prevalence of histiocytic sarcoma and involved with research undertaken by Dr Jane Dobson, and are aware of research at the University of Rennes, with the hope of identifying DNA markers for the condition in the breed. The breed clubs have also worked closely with Dr Jane Dobson at the University of Cambridge. It was highlighted that misdiagnosis of neoplastic conditions could skew the data given for the breed. It was further noted that lymphoma and haemangiosarcoma have anecdotally been reported in the breed.

Whilst no neurological condition was found for the breed in the literature review, the breed representatives raised their concern for the anecdotal rise in idiopathic epilepsy. It was noted that there is difficulty in definitively diagnosing this condition, and that whilst it is currently at a low prevalence in the breed it is highly distressing for owners of affected dogs.

Considering the ocular conditions found in the literature the breed representatives concurred that primary closed angle glaucoma (PCAG) is a concern and the breed clubs have been involved in research for the condition for approximately 30 years. The breed clubs are keen to be involved in any further research opportunities, particularly with regard to dogs that have undergone several tests throughout their life which can give an indication of how the condition develops over time. The Flatcoated Retriever Society currently subsidises testing for dogs over 8 years old. Dr James Oliver has further been collecting data for the AHT's glaucoma project. With regard to the ACVO data provided it was raised that retinopathy is a vague term describing a clinical sign rather than a diagnosis.

Whilst no respiratory condition was noted in the literature review, anecdotal reports of laryngeal paralysis have been seen in the breed. However the prevalence is not considered to be significantly high and it mostly affects older dogs, in common with many similarly-sized breeds.

The breed clubs have been involved in DNA collection and storage with the AHT for dogs affected by renal disease and noted that the condition appeared to be seen more frequently in the past. The Flatcoated Retriever Society currently subsidise sample collection from live affected dogs and encourage owners of immediate relatives to submit samples of their dogs also. The Flatcoated Retriever Society have attempted to develop DNA testing in the past but this did not prove viable at the time. It was agreed that the condition should continue to be monitored, but it has not recently been seen at a high prevalence.

The 2004 and 2014 Purebred and Pedigree Breed Health Survey results were reviewed, with the results supporting the concerns discussed. Further to these, gastric dilatation volvulus/bloat (GDV) and cardiovascular conditions were noted, but at low prevalences.

The insurance data were assessed by the group, and followed the findings from the literature review and the 2004 and 2014 Purebred and Pedigree Breed Health Survey results, with the breed having a higher risk of developing tumours. The insurance data also indicated a higher risk of atopy, cruciate ligament disorders, epilepsy and distichiasis. The breed representatives currently do not consider cruciate disorders to be a particular problem in the UK population. It was surprising to see the Swedish data indicate the breed was at a high risk of hyperthyroidism; rare conditions that occur sporadically may appear as a high relative risk, and this caveat applies here.

Canine Health Schemes data were discussed with overall improvement visible for scores in the BVA/KC Hip Dysplasia Scheme. This contrasts with the trend Estimated Breeding Values (EBVs) for the breed, which have remained fairly static. This suggests that breeders have highly selected against the condition in the past resulting in management and husbandry being the main factor for dysplasia in the current population. It was further noted that the breed have an established culture of hip scoring, and breed club members are expected to do so; this is to be commended and should continue. With regard to elbow dysplasia testing, this is not currently an ABS requirement or recommendation but participation levels are relatively high. Several cases have been anecdotally reported in the past year; the breed clubs are to continue to monitor this condition. Under the BVA/KC/ISDS Eye Scheme the breed is currently on Schedule A for goniodygenesis/primary glaucoma and Schedule B for generalised progressive retinal atrophy (GPR). It was noted that the number of dogs affected by goniodygenesis/primary glaucoma appeared to peak in 2009 with a general decrease since. It was raised that distichiasis is the most commonly witnessed condition from the BVA sightings reports but the numbers of those affected are relatively low.

Genetic diversity measures were discussed, the breed has an estimated effective population size of 67.9, which is within the area at which there is concern. The use of popular sires was noted and is known to highly contribute to loss of genetic diversity. The breed noted that breeders are becoming aware of the implications of using popular sires but this has occurred only recently. It is hoped that the population analyses will be repeated in 2020.

The group agreed from the information provided and their own experience that the priorities for the Flat Coated Retriever were; histiocytic sarcoma, glaucoma, epilepsy and patellar luxation. Dilated cardiomyopathy, cruciate ligament disorders, renal disease and genetic diversity were agreed to be kept at watch.

SECTION 3: ACTION PLAN

- The Kennel Club and Flat Coated Retriever breed clubs to monitor and record the prevalence of neoplasia in the breed and to encourage and consider any research that is available.
- The breed clubs to continue to encourage owners to report to the breed's cause of death register.
- The breed clubs to encourage breeders to consider the potentially harmful consequences arising from the use of popular sires and the impacts on genetic diversity.
- The breed clubs to continue to encourage participation in the BVA/KC Hip and Elbow Dysplasia Schemes.
- The breed clubs to undertake another breed health survey with the Kennel Club to assist in dissemination.
- The breed clubs to continue to encourage participation in the breed's patellar assessment scheme.
- Dr Lewis to examine the data collected to date under the patellar assessment scheme, if sufficient data exists. Input may be sought from Dr Dylan Clements at the University of Edinburgh.
- The Kennel Club to discuss the possibility of a VetCompass study for the breed with Dr Dan O'Neill.
- The Kennel Club will review progress with the Flat Coated Retriever breed representatives in late 2019.

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